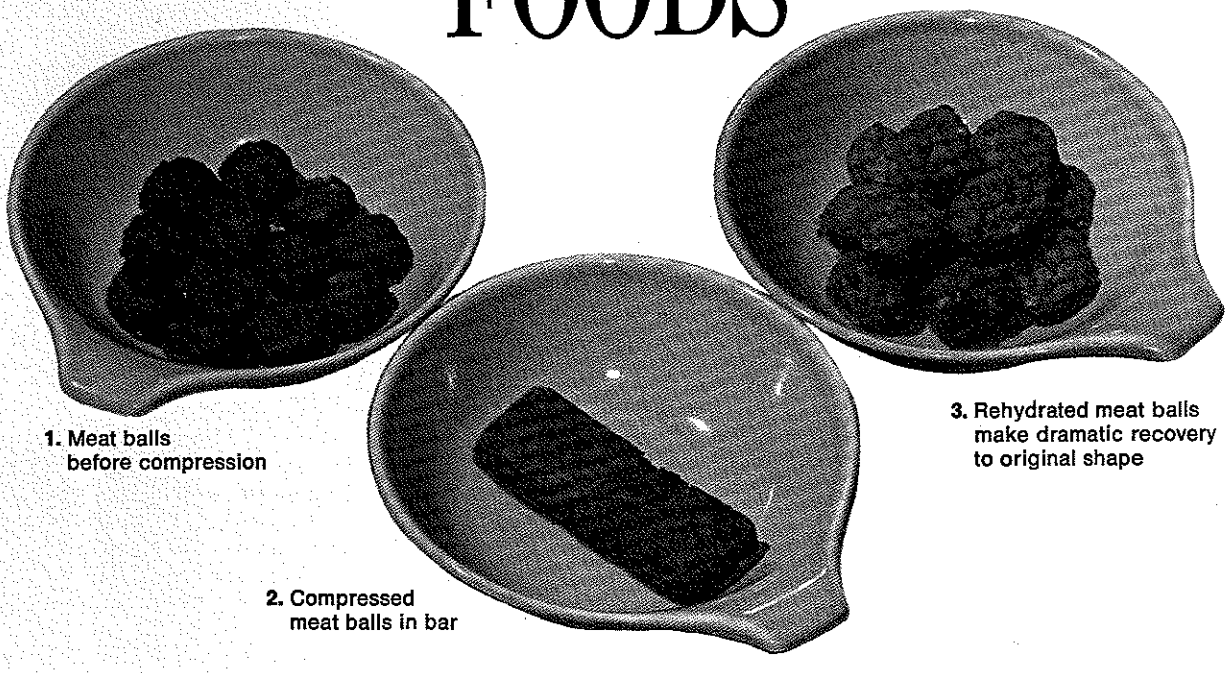
FOODS of TOMORROW
INGREDIENTS · COLORS · FLAVORS · NUTRIENTS · ADDITIVES

NEW CLASS OF FOODS—

COMPRESSED FOODS



1. Meat balls before compression

2. Compressed meat balls in bar

3. Rehydrated meat balls make dramatic recovery to original shape

75-94% volume reduction cuts packaging, storage, and transportation requirements

Coinciding with recent advances in freeze drying and other dehydration techniques, a new class of foods — compressed foods — is being developed which offers numerous space-saving advantages and exhibits remarkably normal textural properties when rehydrated.

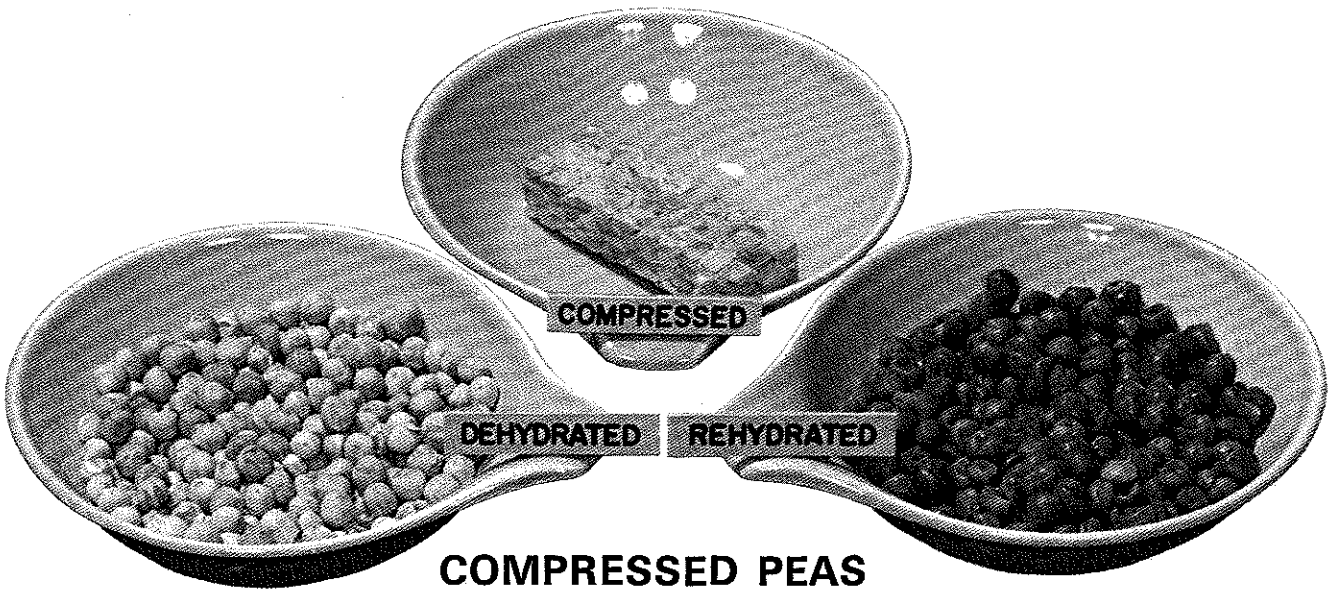
Reversible, compressed foods, upon rehydration, make a complete recovery from a flattened shape to the products' original round or cubed shape and size. Peas or green beans that are practically paper thin when compressed return to round, plump, green, fully shaped vegetables.

Freeze drying and other dehydration techniques can produce dried foods that are of high quality. While the dried foods have the advantages of being shelf stable, light in weight, good color of rehydrated product, and good flavor, they have the disadvantage of being a product with very low density —weight to volume ratio. Compressed foods overcome this disadvantage.

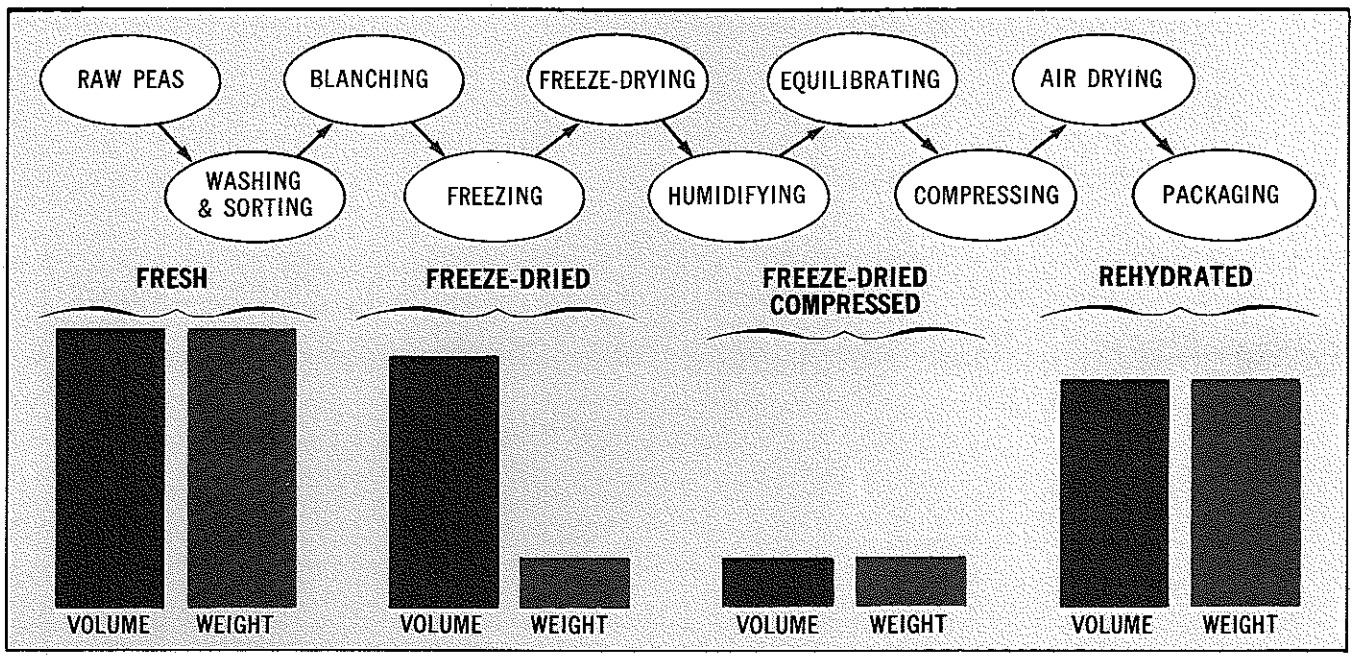
Compressed foods will have wide application in the food service industry where storage space is usually at a premium especially in the food storage and preparation areas. Most food service units now use dehydrated onions and potatoes. With compression, the units will benefit from the lighter weight of dried foods and the minimum storage space needed for compressed foods.

Campers and hikers will benefit from the combination of reduced weight because of drying and reduced volume because of compression. With the reduced volume, significantly less packaging material is used and the material used is easily compressed for efficient removal from camping sites. This should aid pollution control.

Additional major advantages of compressed foods



COMPRESSED PEAS



are: 1) 75% to 94% volume reduction thereby requiring reduced storage and transportation space, 2) 60% to 90% weight reduction by removing moisture during dehydration, and 3) lower freight costs because of volume reduction—easier to transport by campers and hikers.

Development

Research to develop new classes of compressed foods has been sponsored by U.S. Army Natick Laboratories through contracts with various food companies. Two distinct classes of compressed foods, reversible and non-reversible, have been developed and produced in laboratory and pilot operations.

The reversible compressed products make a dramatic shape and volume recovery upon rehydration. Numerous vegetables, fruits, cereals, and formulated products have demonstrated this capability.

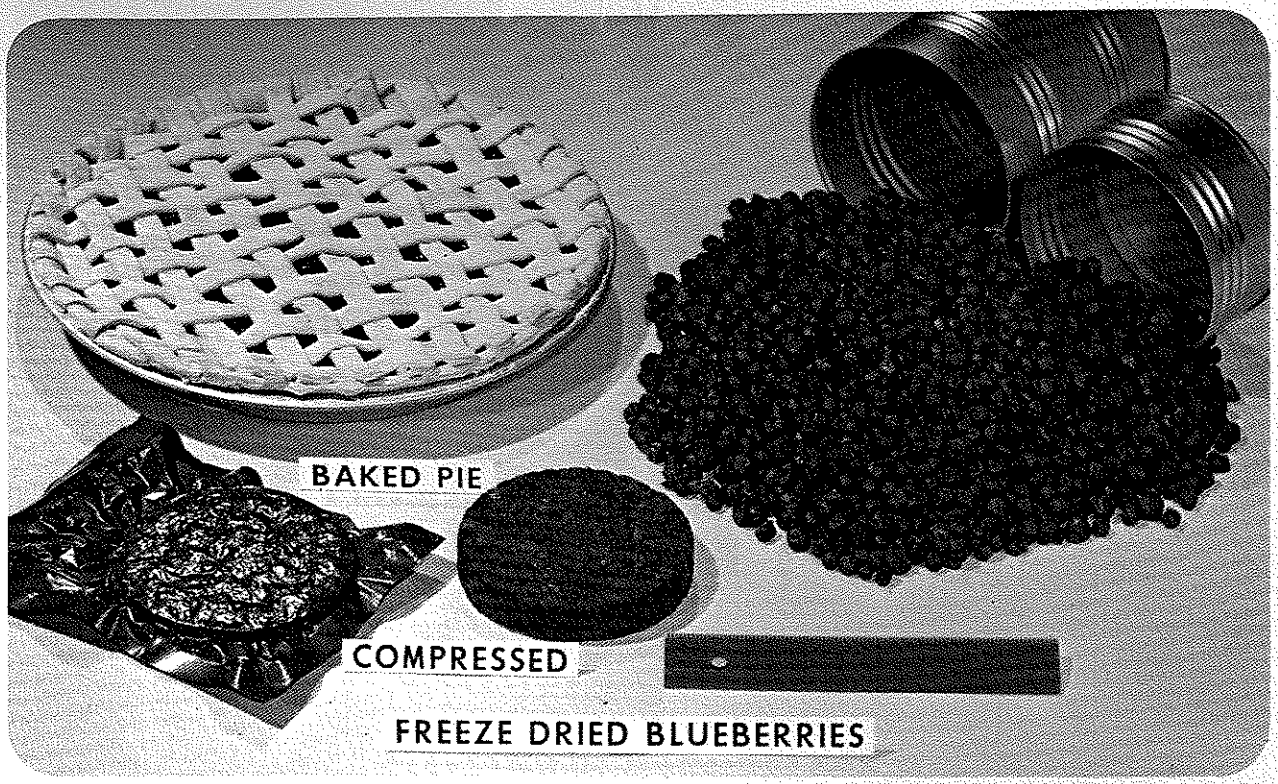
Non-reversible products, as the name indicates, do not possess this characteristic of returning to their original shape upon rehydration. Compressed intermediate moisture fruit bars are in this classification. 14 fruit bar variations have been produced from combinations of figs, dates, pears, cherries, almonds, coconut, orange, sesame, raisin, and macaroons.

Product Usage

Three usage patterns are contemplated for the compressed foods. The food bars are produced for consumption directly from the package while in the compressed state. The items prepared for direct consumption have a higher moisture content and lower compression ratio than the products that receive further preparation before use.

Products in the second usage pattern require re-

COMPRESSED FOODS



Compressed disc of berries, equivalent to pile of uncompressed berries, is sufficient for a 9-inch pie

One can of compressed green beans equals 16 cans of uncompressed product

hydration and usually, though not always, receive additional preparation steps such as cooking or baking before consumption. Reversible compressed items assume their original shape and size during rehydration and preparation for consumption. Freeze dried products successfully produced in this category are green beans, green peas, corn, spinach, carrots, cherries, and blueberries. Air dried onion flakes and dehydrated diced potatoes have also been produced. Potato flakes have not been produced but research personnel are confident that potato flakes will respond equally well to the technique. Dry breakfast cereals such as corn flakes lend themselves to compression with reversible characteristics.

Products in the third usage category, will permit eating the foods directly from the package while still compressed or will permit rehydration, cooking, baking or other preparation steps before consumption. Products in this usage category have been successfully produced, stored (3 months at 38C), and taste panelled (6.2 to 8.0 reading on a 9 point scale). Products were taste panelled as bars directly from the package and as rehydrated products. Panel readings had only minor variations between the two methods of serving. All products demonstrated the reversible characteristic.

Some of the products involved were potato salad, cole slaw, pineapple/cottage cheese, Welsh Rarebit, crabmeat cocktail, chocolate pudding, pineapple pudding, beef stew, chicken and rice, barbecue pork, chicken ala king, chili with beans, shrimp creole, scrambled eggs, tuna salad, mixed vegetables with ham, and apple pie filling.

Compression Ratios and Configurations

Volume reductions, as a result of compression, range from 75% for green peas, corn, and the above meat items to 94% for green beans. Other typical reductions were 80% for air dried onions, 90% for spinach, 93% for carrots, and 92% for freeze dried cherries and blueberries as compared to fresh fruit.

Configuration of the final product can be adjusted to fill various needs. Principal product configuration to-date has been a bar of approximately 3 in × 1 in × ½ in and a disc 3⅜ in in diameter with varying thicknesses. As an example, cherry discs were ½ in thick and blueberries were ⅝ in thick. The 3⅜ in diameter was chosen to facilitate packaging in number 2½ size cans. The bars have been packaged in flexible pouches.

Production Parameters

Fruit bar items were dehydrated to a moisture content of approximately 8% (range 7% to 14%) and compressed at relatively low pressures of approximately 200 p.s.i. Moisture levels below 7% resulted in bars that were too hard and difficult to chew. Addition of 2% lecithin was found to materially improve texture.

Freeze dried vegetable and fruit products were sprayed with a mist to return the moisture content to approximately 12% and compressed. Pressures used during the experimental work ranged from 100 p.s.i. to 5000 p.s.i. with the major portion of the work at pressures of 200 to 2500 p.s.i.

Texture of the rehydrated products, rate of rehydration, texture of the compressed product, and volume are influenced by preparation of the raw product, moisture content at time of compression, and amount of pressure used for compression. After compressing the products, the discs or bars were further dehydrated to reduce the final moisture content to approximately 2%. Consequently, the final compressed product has a weight reduction of approximately 80% (range 60 to 90) and a volume reduction of 75% to 94%.

Quality Evaluation

Quality evaluations were made for 1) hardness of the bar—difficulty in biting, 2) brittleness of bar, 3) storage stability, 4) organoleptic acceptance of dry bar, 5) organoleptic acceptance of rehydrated product, 6) rehydration rates—hot and cold liquids, and 7) breaking of food pieces as a result of compression. Nutritional analysis has verified that the compression technique has no effect on the product nutritionally.

Technological evaluations of pies prepared from compressed cherries and blueberries indicate no significant difference in flavor, texture, and appearance from those prepared from the uncompressed counterpart. One compressed disc of cherries measuring 3⅝ in in diameter and ½ in thick or a 3⅝ × ⅜ disc of blueberries is sufficient for a nine inch pie.

Cost Projections

Because no commercial operations have been carried out, accurate cost information is not available. Savings will materialize from less packaging material usage, less storage space, less transportation weight, and less transportation bulk. Transportation rates on freeze dried products are now based on volume rather than weight. Offsetting these savings will be the cost of the compression operation. Estimates are that this cost will run several cents/lb dry weight basis or about one cent per pound fresh basis. Cost of dehydration will be an additional item of expense. Preliminary "horse-back" estimates are that the total cost, from the raw state to final delivery to the consumer, will be about equal to frozen or canned products. □

Bibliography of publications covering research work on compressed foods is available from Dr. Abdul R. Rahman, Head, Fruits and Vegetables Products Group, Plant Products Division, U.S. Army Natick Laboratories, Natick, Massachusetts 01760.